Atmosphere

GLOBE Inquiry Model: DRAFT OUTLINE SHOWING TIME AND SEQUENCE

Note: *This outline provides you with a framework for agenda planning for implementation of the GLOBE inquiry-based training model. We have provided a basic content outline as well as a timeframe for completion of all activities. Currently, we have plans to develop and distribute complete lesson plan packages for each protocol area by the end of the current calendar year.*

This Outline is ordered as follows:

I. Phenology (3 hours)
II. Atmosphere – Basic (6 hours)
III. Phenology and Atmosphere – Basic (7 hours and 45 minutes)
IV. Atmosphere – Advanced (3 hours 45 minutes)
V. Phenology and Atmosphere – Basic and Advanced (10 hours)

I. GLOBE Phenology

Common thread: Temperature and Precipitation.

Total Training Time: 3 hours

Staffing and support requirements: 1 Master Trainer. Trainer must be prepared to train systems components of Phenology.

Logistics requirements: Trainer must survey workshop location to identify nearby deciduous trees and determine if they are native species

Equipment requirements:

1. Materials needed for phenology training (either laminated samples of bud burst or plastic flowers/leafs, etc.)
2. Laminated copies of the field sheets for each group.
3. Copies of data entry sheets.
4. Stick on (battery operated) 24-hour clock for UT to be attached to fieldwork clipboard or inside of shelter.

Workshop format:

PHENOLOGY— 1 hour 45 minutes

1. Brainstorming/discussion. What defines a season? How do you determine what season you are in? **(15 minutes)**

2. Send participants outside to observe. Look for environmental clues that indicate what season it is. Objective: to list different types of observations tied to the seasons. **(15 minutes)**
3. Discussion of observations. Pose question—how could you define a season? Lead to the direction of the growth cycle: green up/green down. Ask: What clues provided an indication of the seasonal changes? Are there other observations that we could take to determine when each season ends/begins? How could you define a season?" **(15 minutes)**
4. Show climograph depicting the data for temperature and precipitation over year time frame for the location of the workshop. Pose questions such as "What can we see in this data? What patterns do we see? Do we see any seasonal changes?" **(1 hour)**
    a. If we wanted to determine the beginning and ending of a season by monitoring buds opening and leaves growing how would we do it? What would be your ideal source of data? Discussion of constants and variables involved (ie. Trees to use). Mention "special measurements".
    a. Present GLOBE protocols for phenology outside (including GPS and site definition). Use plastic flower/leaf samples for discussion if outside of budding season.

DATA—1 hour
Data Entry - 30 minutes data entry
Visualizations – 30 minutes

1. No Computers
Recommendation: Trainings only occur in a site where computers are available.)
    a. View graphs of data entry and visualizations.
        i. Interpretation using graphs—theme of seasons.
        ii. Brainstorm possible topics for future student projects/debriefing.
    b. Handouts/instructions for email data entry.
2. Computers
All instruction on visualizations and data entry will occur in the Lab.
    a. Web based, online data entry.
    b. Demonstrations and online creation of seasonably dependant Visualizations.
    c. Demonstration of data set creation—finding and locating wealthy data sets for student projects (use the canned data sets show at the beginning of the workshop as an example).

PHENOLOGY SUMMARY—15 minutes
1. What defines a season? Discussion.
2. We have examined many variables that can be examined to monitor the seasons. Are there other things that we could monitor that have seasonal trends?
3. Present data gathered during the week if applicable.
4. Meaningfulness—defining over time. What does it mean? What are scientists doing with the data? What can teacher/student do with this data? Who benefits in our community from this information?
5. Encourage participants to complete training in other areas—Earth as a System

II. GLOBE Atmosphere—Basic

Time: 6 hours (not including breaks/lunch)

Staffing and support requirements: 1 Master Trainer and 1 experienced local/regional Assistant (a GLOBE Certified Trainer who is currently training teachers and is a prospective Master Trainer). Both trainers must be prepared to train systems components of Atmosphere.

Logistics requirements:
1. Atmosphere Trainer gathers data during solar noon of all days between prep day and end of workshop to be presented on the last day of the workshop in a low tech manner.
3. Recommendation: Soil trainer collects soil temperature (and perhaps soil moisture) data to present with atmosphere data to demonstrate what occurs at the atmosphere site within a week time period.

Equipment requirements:
1. Each Master teacher needs 1 Student Inquiry and Research CD and a printed copy of the Atmosphere sourcebook from the CD.
2. Laminated copies of the field sheets for each group.
3. Copies of data entry sheets.
4. Stick on (battery operated) 24-hour clock set to UT to be placed inside of shelter.

Pre-workshop preparation and materials needed:
1. **Site background information and data**
    a. Local or Regional data to graph temperature and precipitation 'representative' of the location of the workshop.
2. **Pre-workshop measurements**
    a. Create map of area surrounding workshop site (ie. 100 square meters, include buildings, trees, roads, bodies of water, etc.) on butcher paper or overhead transparency (used for participants to record temperature differences and site definition).

ATMOSPHERE—3 hours and 45 minutes
Concept: The outcome behind this activity is to model how Trainers present the need for persistent, consistent and accurate data. From this investigative exercise a piece of meteorological data, by itself is of little value. Increasing the measurements provide predictive and environmental modeling perspectives.
1. Start with an open discussion on the perceptions of the atmosphere, right here, right now. Describe the current conditions? What have you experienced, and what are you experiencing now? What changes do you see, or have you experienced? (**15 min**).

2. Place one week of GLOBE data (a seasonably dependant variable such as temperature or precipitation) on a graph. Explain to participants that they do not know anything about the location or time of year represented by this particular data. Ask, "What does this data tell you? How many data are needed to determine the shape of graph? Is it a predictor of seasonal cycles?" Persistent data is needed. **(15 min)**
    a. Show one seasonally dependent datum,
    b. Show the one-month,

c. Three-months,
d. Six-months,
e. One-year graphs

3. Pose the questions "When do data become valuable? What is the right data and at what point do those data become valuable?" Place the discussion in the context of seasonable dependant data and the need for long-term data collection. Thermometer activity outside. **(15 min)**
   a. Use created map of local area to assign each participant a different area to go take a temperature reading.
   b. Ask participants to write the temperature on the map when they return.
   c. Pose the question "What do these data tell us? Are they accurate? If not, how could we make them more accurate?"

4. Now look at the data in a spatial point of view. Where is the majority of our temperature data currently gathered? Discuss the use of airport data. Would the temperature reading be different if we took the measurement at the workshop site? Do airport data alone provide valid information? Consistent and accurate data is valuable and needed. **(15 min)**
   a. Open discussion regarding the variability of the existing data
   b. Discuss choosing a site/site definition.
   c. Walk through completing the site definition sheet so they are prepared to complete this outside.
   d. Clinometer demonstration.
   e. Solar noon.
   f. Common error and calibration.

5. Atmosphere Basic Protocols: preparation inside **(1 hour)**
   a. Cloud Activity. Hand out the cloud packets. Each cloud packet contains the blue circle with a pre-cut amount of torn paper. Participants are to arrange the clouds and guess cloud cover. After activity, collect cloud packets.
      i. Discussion regarding common problems encountered in cloud estimation.
      ii. Discussion regarding cloud type: Use Cloud Triangle.
      iii. Discussion regarding Relative Humidity. Place a pile of ice on the table. Ask the participants to observer the actions/reactions of the ice. Why is it happening, where is the ice going, what is the cause and effect?
   b. Reference to field guide for each protocol regarding common mistakes (ie. Reading measurements from rain gauge).

6. Atmosphere Basic protocols: demonstrations outside**. (1 hour 45 min)**
   Divide participants into two groups—after 1 hour change each group.
   a. Site Definition/Temperature
      i. Max/min/current temperature
      ii. Reading a thermometer
      iii. Calibrating the thermometer.
      iv. Place a small clock inside the shelter set to UT. When the participant asks "What is this?", explain the concept of Universal Time to the group.
   b. Precipitation/Humidity/Clouds
      i. Rain gauge

ii. Snow board
iii. pH and calibration
iv. cloud cover and type
v. Relative Humidity

DATA—2 hours total
Data Entry 45 minutes data entry
Visualizations—1.15 hour

1. No Computers

Recommendation: Trainings only occur in a site where computers are available.)

a. View graphs of data entry and visualizations.
    i. Interpretation using graphs—theme of seasons.
    ii. Brainstorm possible topics for future student projects/debriefing.
b. Supplemental materials: Henzel's CD and handouts. Optional Data Resource Book—printout of selected Atmospheric data items from
c. Handouts/instructions for email data entry.

2. Computers

All instruction on visualizations and data entry will occur in the Lab.

a. Web based, online data entry.
b. Mining for data.
c. Demonstrations and online creation of seasonably dependant Visualizations.
d. Demonstration of data set creation—finding and locating wealthy data sets for student projects (use the canned data sets show at the beginning of the workshop as an example).

ATMOSPHERE SUMMARY—15 minutes

1. What defines a season? Discussion.
2. We have examined many variables that can be examined to monitor the seasons. Are there other things that we could monitor that have seasonal trends?
3. Present data gathered during the week if applicable.
4. Meaningfulness—defining over time. What does it mean? What are scientists doing with the data? What can teacher/student do with this data? Who benefits in our community from this information?
5. Encourage participants to complete training in other areas—Earth as a System

III. GLOBE Phenology/Atmosphere—Basic
Common thread: Temperature and Precipitation.

Total Training Time: 7 hours and 45 minutes

Staffing and support requirements: 1 Master Trainer and 1 experienced local/regional Assistant (a GLOBE Certified Trainer who is currently training teachers and is a prospective Master Trainer). Both trainers must be prepared to train systems components of Atmosphere.

Logistics requirements:

1. Atmosphere shelter must be assembled on prep day before workshop begins.
2. Atmosphere Trainer gathers data during solar noon of all days between prep day and end of workshop to be presented on the last day of the workshop in a low -tech manner.
3. Recommendation: Soil trainer collects soil temperature (and perhaps soil moisture) data to present with atmosphere data to demonstrate what occurs at the atmosphere site within a week time period.

Equipment requirements:

4. Materials needed for phenology training (either laminated samples of bud burst or plastic flowers/leafs, etc.)
5. Each Master teacher needs 1 Student Inquiry and Research CD and a printed copy of the Atmosphere sourcebook from the CD.
6. Laminated copies of the field sheets for each group.
7. Copies of data entry sheets.
8. Stick on (battery operated) 24-hour clock for UT to be attached to fieldwork clipboard or inside of shelter.

Pre-workshop preparation and materials needed:

1. **Site background information and data**
    a. Local or Regional data to graph temperature and precipitation 'representative' of the location of the workshop.
2. **Pre-workshop measurements**
    a. Create map of area surrounding workshop site (ie. 100 square meters, include buildings, trees, roads, bodies of water, etc.) on butcher paper or overhead transparency (used for participants to record temperature differences and site definition).

Workshop format:

PHENOLOGY—1 hour 45 minutes

1. Brainstorming/discussion. What defines a season? How do you determine what season you are in? **(15 minutes)**
2. Send participants outside to observe. Look for environmental clues that indicate what season it is. Objective: to list different types of observations tied to the seasons. **(15 minutes)**
3. Discussion of observations. Pose question—how could you define a season? Lead to the direction of the growth cycle: green up/green down. Ask: What clues provided an indication of the seasonal changes? Are there other observations that we could take to

determine when each season ends/begins? How could you define a season?" **(15 minutes)**

4. Show climograph depicting the data for temperature and precipitation over year time frame for the location of the workshop. Pose questions such as "What can we see in this data? What patterns do we see? Do we see any seasonal changes?" **(1 hour)**
    a. If we wanted to determine the beginning and ending of a season by monitoring buds opening and leaves growing how would we do it? What would be your ideal source of data? Discussion of constants and variables involved (ie. Trees to use). Mention "special measurements".
    b. Present GLOBE protocols for phenology outside (including GPS and site definition). Use plastic flower/leaf samples for discussion if outside of budding season.

ATMOSPHERE—3 hours and 45 minutes

Concept: The outcome behind this activity is to model how Trainers present the need for persistent, consistent and accurate data. From this investigative exercise a piece of meteorological data, by itself is of little value. Increasing the measurements provide predictive and environmental modeling perspectives.

1. Start with an open discussion on the perceptions of the atmosphere, right here, right now. Describe the current conditions? What have you experienced, and what are you experiencing now? What changes do you see, or have you experienced? (**15 min**).

2. Place one week of GLOBE data (a seasonably dependant variable such as temperature or precipitation) on a graph. Explain to participants that they do not know anything about the location or time of year represented by this particular data. Ask, "What does this data tell you? How many data are needed to determine the shape of graph? Is it a predictor of seasonal cycles?" Persistent data is needed. **(15 min)**
    a. Show one seasonally dependent datum,
    b. Show the one-month,
    c. Three-months,
    d. Six-months,
    e. One-year graphs

3. Pose the questions "When does data become valuable? What is the right data and at what point does that data become valuable?" Place the discussion in the context of seasonable dependant data and the need for long-term data collection. Thermometer activity outside. **(15 min)**
    a. Use created map of local area to assign each participant a different area to go take a temperature reading.
    b. Ask participants to write the temperature on the map when they return.
    c. Pose the question "What does this one data point tell us?

4. Now look at the data in a spatial point of view. Where is the majority of our temperature data currently gathered? Discuss the use of airport data. Would the temperature reading be different if we took the measurement at workshop site? Does airport data alone provide valid information? Consistent and accurate data is valuable and needed. **(15 min)**
    a. Open discussion regarding the variability of the existing data

b. Discuss choosing a site/site definition.
c. Walk through completing the site definition sheet so they are prepared to complete this outside on their own.
d. Clinometer demonstration.
e. Solar noon.
f. Common error and calibration.

5. Atmosphere Basic Protocols: preparation inside **(1 hour)**
    a. Cloud Activity. Hand out the cloud packets. Each cloud packet contains the blue circle with a pre-cut amount of torn paper. Participants are to arrange the clouds and guess cloud cover. After activity, collect cloud packets.
        i. Discussion regarding common problems encountered in cloud estimation.
        ii. Discussion regarding cloud type: Use Cloud Triangle.
        iii. Discussion regarding Relative Humidity. Place a pile of ice on the table. Ask the participants to observer the actions/reactions of the ice. Why is it happening, where is the ice going, what is the cause and effect?
6. Atmosphere Basic protocols: demonstrations outside**. (1 hour 45 min)**
   Divide participants into two groups—after 1 hour change each group.
    a. Site Definition/Temperature
        i. Max/min/current temperature
        ii. Reading a thermometer
        iii. Calibrating the thermometer.
        iv. Place a small clock inside the shelter set to UT. When the participant asks "What is this?", explain the concept of Universal Time to the group.
    b. Precipitation/Humidity/Clouds
        i. Rain gauge
        ii. Snow board
        iii. pH and calibration
        iv. cloud cover and type

DATA—2 hours total
Data Entry 45 minutes data entry
Visualizations—1.15 hour

1. No Computers
Recommendation: Trainings only occur in a site where computers are available.)
    a. View graphs of data entry and visualizations.
        i. Interpretation using graphs—theme of seasons.
        ii. Brainstorm possible topics for future student projects/debriefing.
    b. Supplemental materials: Henzel's CD and handouts. Optional Data Resource Book—printout of selected Atmospheric data items from
    c. Handouts/instructions for email data entry.
2. Computers
All instruction on visualizations and data entry will occur in the Lab.
    a. Web based, online data entry.
    b. Mining for data.
    c. Demonstrations and online creation of seasonably dependant Visualizations.

d. Demonstration of data set creation—finding and locating wealthy data sets for student projects (use the canned data sets show at the beginning of the workshop as an example).
e. Brainstorm possible topics for future projects/debriefing.

PHENOLOGY/ATMOSPHERE SUMMARY—15 minutes

1. What defines a season? Discussion.
2. We have examined many variables that can be examined to monitor the seasons. Are there other things that we could monitor that have seasonal trends?
3. Present data gathered during the week (if week-long workshop).
4. Meaningfulness—defining over time. What does it mean? What are scientists doing with the data? What can teacher/student do with this data? Who benefits in our community from this information?
5. Encourage participants to complete training in other areas—Earth as a System.

IV. GLOBE Atmosphere—Advanced (Aerosol/Ozone)

Time: 3 hours 45 minutes

Staffing and support requirements: 1 Master Trainer and 1 experienced local/regional Assistant (a GLOBE Certified Trainer who is currently training teachers and is a prospective Master Trainer). Both trainers must be prepared to train systems components of Atmosphere.

Logistics requirements:

1. Ozone shelter must be assembled on prep day before workshop begins.
2. Atmosphere Trainer gathers data during all days between prep day and end of workshop to be presented on the last day of the workshop in a low tech manner.

Equipment requirements:

1. Each Master teacher needs 1 Student Inquiry and Research CD and a printed copy of the Atmosphere sourcebook from the CD.
2. Laminated copies of the field sheets for each group.
3. Copies of data entry sheets.
4. Stick on (battery operated) 24-hour clock set to UT to be placed on fieldwork clipboard or inside of shelter.

Pre-workshop preparation and materials needed:

1. **Site background information and data:**
    a. Trainer must conduct a search of available GLOBE aerosol and ozone data. Check for historical ozone data of training site.
2. **Pre-workshop measurements:**
    a. Sunshine permitting, trainers should collect aerosol data on prep day.

Workshop format: Advanced Atmosphere—2 hours and 15 minutes

Note: The sun is a requirement for the Aerosol protocol so adjustments may need to be made in the timing of this training (Ie. Ozone training can take place first if sun is obscured).

1. Aerosol **(1 hour)**.
    a. What are aerosols? (see if anyone knows) Provide them with the knowledge that they are particles in the atmosphere
    b. "Do you think particles in the atmosphere could affect plants?" "How?"
    c. What do plants require? (get someone to say sunlight)
    d. Discuss cyclic (seasonal) burning, forest fire "season"
    e. Discuss aerosols in class.
    f. Outside data reading.
2. Ozone **(1 hour 15 min).**
    a. Hang strip outside.
    b. What factors might affect plant health? Anything in the atmosphere? (if Aerosols already completed, "besides aerosols")
    c. Introduce effects of surface ozone on plant (and animal) tissue
    d. Discuss in class/The "Why" Approach.
    e. Outside data reading/discussion of findings.
    f. Refer to Jack Fishman's development piece for outside reading.

DATA—1 hour 15 min total
Data Entry 45 minutes data entry
Visualizations—30 min

1. No Computers

Recommendation: Trainings only occur in a site where computers are available.)

a. View graphs of data entry and visualizations.
    i. Interpretation using graphs—theme of seasons.
    ii. Brainstorm possible topics for future student projects/debriefing.
b. Supplemental materials: Henzel's CD and handouts. Optional Data Resource Book—printout of selected Atmospheric data items from
c. Handouts/instructions for email data entry.

2. Computers

All instruction on visualizations and data entry will occur in the Lab.

a. Web based, online data entry.
b. Mining for data.
c. Demonstrations and online creation of seasonably dependant Visualizations.
d. Demonstration of data set creation—finding and locating wealthy data sets for student projects (use the canned data sets show at the beginning of the workshop as an example).
e. Brainstorm possible topics for future projects/debriefing.

ATMOSPHERE SUMMARY—15 minutes

1. What defines a season? Discussion.
2. We have examined many variables that can be examined to monitor the seasons. Are there other things that we could monitor that have seasonal trends?
3. Present data gathered during the week (if week-long workshop).
4. Meaningfulness—defining over time. What does it mean? What are scientists doing with the data? What can teacher/student do with this data? Who benefits in our community from this information?
5. Encourage participants to complete training in other areas—Earth as a System.

V. GLOBE Phenology and Atmosphere - Basic and Advanced
Common thread: Temperature and Precipitation.

Total Training Time: 10 hours

Staffing and support requirements: 1 Master Trainer and 1 experienced local/regional Assistant (a GLOBE Certified Trainer who is currently training teachers and is a prospective Master Trainer). Both trainers must be prepared to train systems components of Atmosphere.

Logistics requirements:

1. Atmosphere and Ozone shelters must be assembled on prep day before workshop begins.
2. Atmosphere Trainer gathers data during solar noon of all days between prep day and end of workshop to be presented on the last day of the workshop in a low -tech manner.
3. Recommendation: Soil trainer collects soil temperature (and perhaps soil moisture) to present with atmosphere data to demonstrate what occurs at the atmosphere site within a week time period.

Equipment requirements:

1. Materials needed for phenology training (either laminated samples of bud burst or plastic flowers/leafs, etc.)
2. Each Master teacher needs 1 Student Inquiry and Research CD and a printed copy of the Atmosphere sourcebook from the CD.
3. Laminated copies of the field sheets for each group.
4. Copies of data entry sheets.
5. Stick on (battery operated) 24-hour clock for UT to be attached to fieldwork clipboard or inside of shelter.

Pre-workshop preparation and materials needed:

1. **Site background information and data**
    a. Local or Regional data to graph temperature and precipitation 'representative' of the location of the workshop.
    b. Trainer must conduct a search of available GLOBE aerosol and ozone data. Check for historical ozone data of training site.
2. **Pre-workshop measurements**
    a. Create map of area surrounding workshop site (ie. 100 square meters, include buildings, trees, road, water bodies, etc.) on butcher paper or overhead transparency (used for participants to record temperature differences and site definition).
    b. Sunshine permitting, trainers should collect aerosol data on prep day.

Workshop format:

PHENOLOGY— 1 hour 45 minutes

1. Brainstorming/discussion. What defines a season? How do you determine what season you are in? **(15 minutes)**
2. Send participants outside to observe. Look for environmental clues that indicate what season it is. Objective: to list different types of observations tied to the seasons. **(15 minutes)**

3. Discussion of observations. Pose question—how could you define a season? Lead to the direction of the growth cycle: green up/green down. Ask: What clues provided an indication of the seasonal changes? Are there other observations that we could take to determine when each season ends/begins? How could you define a season?" **(15 minutes)**
4. Show climograph depicting the data for temperature and precipitation over year time frame for the location of the workshop. Pose questions such as "What can we see in this data? What patterns do we see? Do we see any seasonal changes?" **(1 hour)**
    a. If we wanted to determine the beginning and ending of a season by monitoring buds opening and leaves growing how would we do it? What would be your ideal source of data? Discussion of constants and variables involved (ie. Trees to use). Mention "special measurements".
    b. Present GLOBE protocols for phenology outside (including GPS and site definition). Use plastic flower/leaf samples for discussion if outside of budding season.

ATMOSPHERE—6 hours

Concept: This activity is designed to model how Trainers present the need for persistent, consistent and accurate data. From this investigative exercise a piece of meteorological data, by itself is of little value. Increasing the measurements provide predictive and environmental modeling perspectives.

1. Start with an open discussion on the perceptions of the atmosphere, right here, right now. Describe the current conditions? What have you experienced, and what are you experiencing now? What changes do you see, or have you experienced? (Not to exceed **15 min**).

2. Place one week of GLOBE data (a seasonably dependant variable such as temperature or precipitation) on a graph. Explain to participants that they do not know anything about the location or time of year represented by this particular data. Ask, "What does this data tell you? How many data are needed to determine the shape of graph? Is it a predictor of seasonal cycles?" Persistent data is needed. **(15 min)**
    a. Show one seasonally dependent datum,
    b. Show the one-month,
    c. Three-months,
    d. Six-months,
    e. One-year graphs

3. Pose the questions "When does data become valuable? What is the right data and at what point does that data become valuable?" Place the discussion in the context of seasonable dependant data and the need for long-term data collection. Thermometer activity outside. **(15 min)**
    a. Use created map of local area to assign each participant a different area to go take a temperature reading.
    b. Ask participants to write the temperature on the map when they return.
    c. Pose the question "What does this one data point tell us?

4. Now look at the data in a spatial point of view. Where is the majority of our temperature data currently gathered? Discuss the use of airport data. Would the temperature reading

be different if we took the measurement at workshop site? Does airport data alone provide valid information? Consistent and accurate data is valuable and needed. **(15 min)**

a. Open discussion regarding the variability of the existing data
b. Discuss choosing a site/site definition.
c. Walk through completing the site definition sheet so they are prepared to complete this outside on their own.
d. Clinometer demonstration.
e. Solar noon.
f. Common error and calibration.

5. Atmosphere Basic Protocols: preparation inside **(1 hour)**
    a. Cloud Activity. Hand out the cloud packets. Each cloud packet contains the blue circle with a pre-cut amount of torn paper. Participants are to arrange the clouds and guess cloud cover. After activity, collect cloud packets.
        i. Discussion regarding common problems encountered in cloud estimation.
        ii. Discussion regarding cloud type: Use Cloud Triangle.
        iii. Discussion regarding Relative Humidity. Place a pile of ice on the table. Ask the participants to observer the actions/reactions of the ice. Why is it happening, where is the ice going, what is the cause and effect?
    b. Reference to field guide for each protocol regarding common mistakes (ie. Reading measurements from rain gauge).
6. Atmosphere Basic protocols: demonstrations outside**. (1 hour 45 minutes)**
   Divide participants into two groups—after 1 hour change each group.
    a. Site Definition/Temperature
        i. Max/min/current temperature
        ii. Reading a thermometer
        iii. Calibrating the thermometer.
        iv. Place a small clock inside the shelter set to UT. When the participant asks "What is this?", explain the concept of Universal Time to the group.
    b. Precipitation/Humidity/Clouds
        i. Rain gauge
        ii. Snow board
        iii. pH and calibration
        iv. cloud cover and type
        v. Relative Humidity

7. Atmosphere Advanced Protocols: Aerosol/Ozone. **(2 hours 15 minutes)**

Note: The sun is a requirement for the Aerosol protocol so adjustments may need to be made in the timing of this training (Ie. Ozone training can take place first if sun is obscured).

a. Aerosol **(1 hour)**.
    i. What are aerosols? (see if anyone knows) Provide them with the knowledge that they are particles in the atmosphere
    ii. "Do you think particles in the atmosphere could plants?" "How?"
    iii. What do plants require? (get someone to say sunlight)
    iv. Discuss cyclic (seasonal) burning, forest fire "season,"
    v. Discuss aerosols in class.
    vi. Outside data reading.
b. Ozone **(1 hour 15 minutes).**

i. Hang strip outside.
ii. What factors might affect plant health? Anything in the atmosphere? (if Aerosols already completed, "besides aerosols")
iii. Introduce effects of surface ozone on plant (and animal) tissue
iv. Discuss in class/The "Why" Approach.
v. Outside data reading/discussion of findings.
vi. Refer to Jack Fishman's development piece for outside reading.

DATA—1 hour 45 minutes total
Data Entry 45 minutes data entry
Visualizations—1 hour

1. No Computers

Recommendation: Trainings only occur in a site where computers are available.)

a. View graphs of data entry and visualizations.
    i. Interpretation using graphs—theme of seasons.
    ii. Brainstorm possible topics for future student projects/debriefing.
b. Supplemental materials: Research CD and handouts. Optional Data Resource Book—printout of selected Atmospheric data items
c. Handouts/instructions for email data entry.

2. Computers

All instruction on visualizations and data entry will occur in the Lab.

a. Web based, online data entry.
b. Mining for data.
c. Demonstrations and online creation of seasonably dependant Visualizations.
d. Demonstration of data set creation—finding and locating wealthy data sets for student projects (use the canned data sets show at the beginning of the workshop as an example).
e. Brainstorm possible topics for future projects/debriefing.

PHENOLOGY/ATMOSPHERE SUMMARY—30 minutes

1. What defines a season? Discussion.
2. We have examined many variables that can be examined to monitor the seasons. Are there other things that we could monitor that have seasonal trends?
3. Present data gathered during the week (if week-long workshop).
4. Meaningfulness—defining over time. What does it mean? What are scientists doing with the data? What can teacher/student do with this data? Who benefits in our community from this information?
5. Encourage participants to complete training in other areas—Earth as a System